

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 488 023 A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 91119709.3

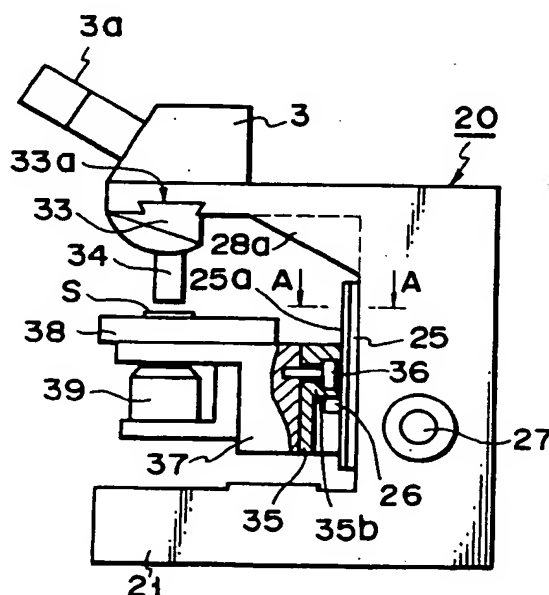
(51) Int. Cl.⁵: G02B 21/26

(22) Date of filing: 19.11.91

(30) Priority: 19.11.90 JP 313583/90

(43) Date of publication of application:
03.06.92 Bulletin 92/23(84) Designated Contracting States:
DE FR GB(71) Applicant: OLYMPUS OPTICAL CO., LTD.
43-2, 2-chome, Hatagaya Shibuya-ku
Tokyo 151(JP)(72) Inventor: Hasegawa, Takashi, c/o Intell. Prop.
& Legal Dep.
Olympus Optical Co., Ltd., 2-3,
Kuboyama-cho
Hachioji-shi, Tokyo(JP)(74) Representative: KUHNEN, WACKER &
PARTNER
Alois-Steinecker-Strasse 22 Postfach 1553
W-8050 Freising(DE)(54) **Microscope having a focus-adjusting mechanism.**

(57) Disclosed herein is a microscope which comprises main unit (20) comprising a base (21), an arm body (22) mounted on and fixed to the base (21), an arm top (23), a revolver (33) attached to the arm top (23), an objective (34) attached to the revolver (33), a lens barrel (3) held by the arm top (23), and an eyepiece (39) attached to the lens barrel (3), a stage (38) for supporting a specimen (s), a movable member (25) connected to the front of the arm body (22), opposing the specimen (s) supported on the stage (38), and capable of moving in vertical direction, a revolver/stage holder (37, 40) attached to the movable member (25), for holding the revolver or the stage (38), a focus adjustment knob (27) coupled to the arm body (22), a focus-adjusting mechanism located within the arm body (22), mechanically connected to the movable member (25) and the focus adjustment knob (27), for moving the movable member (25) in the vertical direction for a distance proportional to an angle through which the knob (27) is rotated, a first revolver holder (24) secured to the arm top (23), for holding the revolver (33), and a stage support (60) to be mounted on the base (21) in the case where the objective (34) is moved in order to achieve focusing.

**FIG. 2****EP 0 488 023 A1**

The present invention relates to a microscope, and more particularly to an improved focus-adjusting mechanism for use in a microscope.

Various focus-adjusting mechanisms are used in microscopes. Four microscopes, each having a focus-adjusting mechanism, will be described with reference to Figs. 9 to 12.

The microscope shown in Fig. 9 comprises a main unit 1, a lens barrel 3, a revolver 4, and an objective 5. The main unit 1 has an arm top 2 and arm body 6. The barrel 3 is connected at its lower end to the arm top 2 and has an eyepiece 3a fixed to its upper end. The revolver 4 is also connected to the arm top 2. The objective 5 is fixed to the revolver 4. The eyepiece 3a and the objective 5 are placed in the same viewing axis. The microscope further comprises a movable support 7, a stage 8, a stage holder 9, a focus adjustment knob 10, and a focus-adjusting mechanism (not shown). The movable support 7 is mounted on the front of the arm body 6 and can slide up and down, in parallel to the viewing axis. The stage 8 is held by the holder 9, which is fastened to the support 7. The focus adjustment knob 10 is mounted on one side of the arm body 6. The focus-adjusting mechanism is housed within the arm body 6 and connected to the focus adjustment knob 10. In operation, a specimen S put on the stage 8 and placed on the viewing axis. Then, the knob 10 is rotated, thus driving the focus-adjusting mechanism. The focus-adjusting mechanism moves the support 7 vertically. As a result, the stage 8 is moved up or down, bringing the specimen S to the focal point of the objective 5.

The microscope shown in Fig. 10 is characterized in two respects. First, the stage holder 12 is immovably secured to the main unit 11. Second, the focus adjustment knob 10 and the revolver 13 are coupled to the focus-adjusting mechanism 14 housed within the main unit 11. Hence, as the knob 10 is rotated, the revolver 13 having an objective is moved vertically, whereby the focal point of the objective is moved to the specimen S.

The microscope shown in Fig. 11 is characterized in that the arm top 16 is slidably attached to the arm body 15 of the main body 1. As the focus adjustment knob 10 is rotated, the arm top 16 is moved up or down, whereby the focal point of the objective is moved to the specimen S.

The microscope shown in Fig. 12 is identical to the microscope of Fig. 11, except for three respects. First, a fixed support 17 containing an auxiliary focus-adjusting mechanism (not shown) is fastened to the main unit 1. Second, an auxiliary focus adjustment knob 19 is mounted on one side of the support 17 and connected to the auxiliary focus adjustment mechanism. Third, the stage holder 18 is slidably attached to the fixed support

17 and driven by the auxiliary focus-adjusting mechanism. Hence, the objective and the stage are independently moved vertically when the knobs 10 and 19 are rotated.

In the microscope shown in Fig. 9, the stage 8 can have but limited size and rigidity since it is supported by a pole guide or a roll guide and is moved vertically to accomplish focus adjustment. Hence, the stage 8 cannot support a relatively heavy specimen, and is likely to be deformed, which results in various problems in microscopic observation.

The microscope shown in Fig. 10, wherein the objective is moved up and down to achieve focusing, is disadvantageous. The distance between the objective and the lens barrel 3 is long unless the objective is an infinity type. Consequently, various optical deteriorations such as insufficiency of ambient light occur, making it impossible for the microscope to have an adequate focusing stroke.

In the microscopes shown in Figs. 11 and 12, the arm top 16 can have but limited rigidity since it is moved vertically to effect focus adjustment. Thus, it would be impossible to mount a camera on the top arm.

The object of the present invention is to provide a microscope having a focus-adjusting mechanism, in which either the specimen-supporting section or the objective-supporting section can be moved in order to achieve focus adjustment, and which enables a user to observe specimens of various weights in a desired magnification.

According to the invention, there is provided a microscope which comprises: main unit comprising a base, an arm body mounted on and fixed to the base, an arm top, a revolver attached to the arm top, an objective attached to the revolver, a lens barrel held by the arm top, and an eyepiece attached to the lens barrel; a stage for supporting a specimen; a movable member connected to the front of the arm body, opposing the specimen supported on the stage, and capable of moving in vertical direction; a revolver/stage holder attached to the movable member, for selectively holding one of the revolver or the stage; a focus adjustment knob coupled to the arm body; a focus-adjusting mechanism located within the arm body, mechanically connected to the movable member and the focus adjustment knob, for moving the movable member in the vertical direction for a distance proportional to an angle through which the knob is rotated; a first revolver holder secured to the arm top, for holding the revolver; and a stage support to be mounted on the base in the case where the objective is moved in order to achieve focusing.

In the microscope of the invention, either the objective or the stage is moved vertically to achieve focusing.

To move the objective vertically, first the holder holding the revolver is attached to the movable member, and then the stage is mounted on the base. Next, the focus adjustment knob is rotated, thus driving the focus-adjusting mechanism. The mechanism moves the movable member vertically, thereby moving the holder up or down. As a result, the revolver is moved vertically, whereby the objective is so moved, achieving focusing. If the specimen is a heavy one, the stage is put on the base, so that the stage and the base cooperate to support the heavy specimen steadily. The specimen, though heavy, is supported steadily, and can be observed with good focusing. Since the revolver, not the arm top as a whole, is moved vertically along with the movable member, the load on the arm top is relatively small, making it possible to mount a heavy device (e.g., a camera) on the arm top. Further, since the movable member attached to the arm body is moved, too, the optical axis of the objective is not so deviated from that of the eyepiece, as in the case where only the revolver is vertically.

To move the stage to achieve focus adjustment, the holder supporting the stage is attached to the movable member, and the revolver holding the objective is attached to the holder of the arm top. As the focus adjustment is rotated, thus driving the focus-adjusting mechanism, the movable member is moved, whereby the stage is moved vertically, bringing the specimen toward or away from the objective.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a side view showing the main unit of a microscope according to a first embodiment of the invention;

Fig. 2 is a side view of the microscope set in the mode wherein the stage is moved to achieve focusing;

Fig. 3 is a cross-sectional view, taken along line A-A in Fig. 2;

Fig. 4 is a side view showing the microscope set in the mode wherein the objective is moved to achieve focusing;

Fig. 5 is a side view showing the main body of a microscope according to a second embodiment of the invention;

Fig. 6 is a side view showing the microscope of Fig. 5, which is set in the mode wherein the stage is moved to achieve focusing;

Fig. 7 is a side view showing the microscope of Fig. 5, which is set in the mode wherein the objective is moved to achieve focusing;

Fig. 8 is a schematic representation of the illumination system incorporated in the microscope

shown in Fig. 5;

Fig. 9 shows a microscope having a first conventional focus-adjusting mechanism;

Fig. 10 shows a microscope having a second conventional focus-adjusting mechanism;

Fig. 11 shows a microscope having a third conventional focus-adjusting mechanism; and

Fig. 12 shows a microscope having a fourth conventional focus-adjusting mechanism.

Embodiments of the present invention will now be described, with reference to the accompanying drawings.

Figs. 1 to 4 show a microscope according to a first embodiment of the invention. As shown in Fig. 1, the microscope comprises a main unit 20. The main unit 20 comprises a base 21, an arm body 22, and an arm top 23. The top of the arm top 23 is flat. A dovetail groove 24 is formed in the lower surface of the arm top 23. The base 21 is a hollow block and has a seat 31. The seat 31 has a through hole 32.

The microscope further has a lens barrel 3, a movable support 25, a positioning pin 26, a focus adjustment knob 27, and a focus-adjusting mechanism (not shown). The barrel 3 is secured to the top of the top arm 23. The support 25 is mounted on the front of the arm body 22 and can move up and down. The movable support 25 has a vertical dovetail tenon 25a formed on its front. The positioning pin 26 protrudes from the front of the support 25. The focus adjustment knob 27 is mounted on one side of the arm body 22.

The focus-adjusting mechanism is located within the main unit 20 and is coupled to the movable support 25. The mechanism is connected to the focus adjustment knob 27. It comprises a lack extending in vertical direction and a pinion set in engagement with the lack. The lack is fastened to the movable support 25, and the pinion is connected to the focus adjustment knob 27. Hence, the mechanism drives the support 25 upwards and down wards as the knob 27 is rotated in one direction and the opposite direction.

Two rectangular brackets 28a and 28b (only the bracket 28b is shown in Fig. 1) are fixed in the corner defined by the arm body 22 and the arm top 23, thus rendering the arm top 23 rigid. The brackets 28a and 28b are parallel to each other and so positioned that the upper end of the movable support 25 can move into the space between the brackets 28a and 28b. The support 25 can therefore has a sufficient focusing stroke.

As is shown in Fig. 2, the microscope further comprises a revolver 33, an objective 34, a stage holder, and a stage 38. The revolver 33 has a dovetail tenon 33a. The objective 34 is attached to the revolver 33. The stage holder comprises an adapter 35 and a support 37. The adapter 35 has a

thick portion 35b, and is fastened to the support 37 a screw 36. As is shown in Fig. 3 which is a cross-sectional view taken along line A-A in Fig. 2, the thick portion 35b of the adapter 35 has a dovetail groove 35a formed in that surface facing away from the support 37.

Fig. 2 shows the microscope set in an operating mode (hereinafter called "stage-moving mode"), in which the stage 38 is moved to achieve focusing. To operate the microscope in the stage-moving mode, the dovetail tenon 33a of the revolver 33 is fitted into the dovetail groove 24 of the arm top 23, and the revolver 33 is thereby connected to the arm top 23. Next, the revolver 33 is rotated, placing the objective 34 on the viewing axis of the microscope. Then, the stage holder is mounted onto the movable support 25, with the dovetail tenon 25a of the support 25 fitted in the dovetail groove 35a of the adapter 35. The stage holder is thereby connected to the support 25. The thick portion 35b of the adapter 35 abuts on the positioning pin 26 protruding from the front of the movable support 25, whereby the stage holder is set at a predetermined position with respect to the support 25. The pin position of the positioning pin 26 can be changed by an operator. Next, the stage 38 is put on the upper surface of the support 37, and a specimen S is placed on the stage 38. A condenser mount is fixed to the lower surface of the support, and a condenser 39 is placed on the mount, with its axis aligned with the viewing axis of the microscope. The condenser 39 can therefore gather the light applied from the light source (not shown) provided within the base 21 and applies the light to the specimen S through holes (not shown) made in the support 37 and the stage 38, thereby illuminating the specimen S.

Fig. 4 shows the microscope set in another operating mode (hereinafter called "objective-moving mode") in which the objective 34 is moved to achieve focusing. To set the microscope in the objective-moving mode, a revolver holder 40 is attached to the movable support 25, and a stage fastener 41 is secured to the base 32.

The revolver holder 40 has a substantially L-shaped cross section, and comprises a horizontal member and a vertical member. The horizontal member has a dovetail groove 40a in the lower surface. A revolver 33' is connected to the revolver holder 40, with its tenon fitted in the dovetail groove 40a of the holder 40. The vertical member has a dovetail groove (not shown) in that surface facing the movable support 25. The holder 40 is mounted onto the support 25, with the dovetail tenon 25a of the support 25 fitted in the dovetail groove of the holder 40. The revolver holder 40 is thereby connected to the movable support 25. The lower end of the vertical member abuts on the

positioning pin 26 protruding from the support 25, whereby the stage fastener is set at a predetermined position with respect to the movable support 25.

The stage fastener 41 has a L-shaped cross section, like the revolver holder 40. It is fastened at its lower end to the base 21 by a screw 42. A stage 38' is mounted on the upper surface of the stage fastener 41. A specimen S is put on the stage 38'. A condenser mount is fixed to the lower surface of the support, and a condenser 39' is placed on the mount, with its axis aligned with the viewing axis of the microscope. The condenser 39' can therefore gather the light applied from the light source provided within the base 21 and applies the light to the specimen S through holes (not shown) made in the stage fastener 41 and the stage 38', thereby illuminating the specimen S.

The microscope is set in the stage-moving mode when the specimen S is light, or when the microscope needs to have a long focusing stroke. In other words, the stage holder and the revolver 33 have been attached to the movable support 25 and the arm top 23, respectively. Thereafter, as the focus adjustment knob 27 is rotated in one direction or the other, the focus-adjusting mechanism drives the stage 38 upwards or downward, thereby accomplishing focusing.

The microscope is set in the objective-moving mode when the specimen S is heavy. More specifically, as is shown in Fig. 4, the revolver holder 40 is attached to the support 25, and the stage fastener 41 is secured to the seat 31 of the base 21. Since the stage fastener 41 is fixed directly to the base 21, it is rigid enough to support the heavy specimen S steadily. Since the objective 34 can easily be moved toward and away from the specimen S, it is easy to perform focusing.

In the embodiment shown in Figs. 1 to 4, the stage holder which is a movable member is attached to the movable support 25 when the specimen S is relatively light, and the revolver holder 40, also a movable member, is attached to the movable support 25 when the specimen S is relatively heavy. In either case, the support 25 is moved vertically as the focus adjustment knob 27 is rotated in one direction or the other, thereby moving the specimen S toward or away from the objective 34, or moving the objective 34 toward or away from the stage 38'.

As has been described, in the stage-moving mode, the revolver 33 is attached to the arm top 23; in the objective-moving mode, the revolver 33' is attached to the revolver holder 40. Since both the arm top 23 and the revolver holder 40 are rigid enough to hold the revolver, the objective 34 is held steadily, making it possible to perform accurate focusing, whether the microscope is set in

the stage-moving mode when the specimen S is a light one, or the objective-moving mode when the specimen S is a heavy one.

Moreover, the microscope is advantageous in that the stages 38 and 38' can be one and the same, so can be the condensers 39 and 39', and so can be the revolvers 33 and 33'. Needless to say, the objective 34 can be used in both the stage-moving mode and the objective-moving mode.

Figs. 5 to 8 show a microscope according to a second embodiment of the invention. As is shown in Fig. 5, the microscope comprises a main unit 50, which in turn comprises a base 51, an arm body 52 and an arm top 53. The base 51 has a dovetail tenon 51a on its upper surface. A movable support 25 is mounted on the front of the arm body 52. The support 25 of the same type as the one used in the first embodiment, and has a vertical dovetail tenon 25a formed on its front. The arm top 53 has a dovetail groove 53a in its lower surface. A focus adjustment knob 27 is mounted on one side of the arm body 52 and connected to a focus-adjusting mechanism (not shown) which is located within the arm body 52 and of the same type as the one used in the first embodiment. Hence, the mechanism drives the support 25 upwards and down wards as the knob 27 is rotated in one direction and the opposite direction.

As is shown in Figs. 5 and 6, the microscope further has a lens barrel 54, an eyepiece 55, a reflected flood tube 56, a lamp housing 57. The lens barrel 54 is secured to the top of the top arm 53, and contains the eyepiece 55 which has an optical axis aligned with the viewing axis of the microscope. The reflected flood tube 56 is connected, at one end, to the lens barrel 54 and, at the other end, the lamp housing 57. The housing 57 contains a illumination lamp (not shown). The tube 56 guides illumination light from the lamp to the lens barrel 54.

The microscope has a reflected flood system of the type shown in Fig. 8. This system comprises a set of lenses 58 contained in the reflected flood tube 57, a ring mirror 59 located within the lens barrel 54, and a ring lens 36 located in a barrel 35 which also contains an objective 34. The light beams emitted by the lamp (not shown) pass through the lenses 58 into the lens barrel 54. In the barrel 54, the ring mirror 59 reflects the light beam by 90°. The light beams, thus reflected, pass through the annular space between the objective 34 and the inner surface of the barrel 36, illuminating a specimen S.

As is shown in Fig. 5, two rectangular brackets 28a and 28b are fixed in the corner defined by the arm body 52 and the arm top 53, thus rendering the arm top 53 rigid. The brackets 28a and 28b are

parallel to each other and so positioned that the upper end of the movable support 25 can move into the space between the brackets 28a and 28b. The support 25 can therefore has a sufficient focusing stroke.

Fig. 6 shows the microscope set in the stage-moving mode, in which a stage 59 is moved to achieve focusing. To operate the microscope in the stage-moving mode, the dovetail tenon of a revolver 33 is fitted into the dovetail groove 53a of the arm top 53, where by the revolver 33 is connected to the arm top 53. Next, a stage/revolver holder 58 is attached to the movable support 25. More specifically, the holder 58 is mounted on the movable support 25, with the dovetail tenon 25a of the support 25 fitted in the dovetail groove (not shown) of the stage/revolver holder 58. Then, the stage 59 is mounted on the stage/revolver holder 58, with the dovetail tenon 58a of the holder 58 fitted in the dovetail groove made in the lower surface of the table 59. The specimen S is placed on the stage 59.

Fig. 7 shows the microscope set in the objective-moving mode, in which the objective 34 is moved to achieve focusing. To set the microscope in the objective-moving mode, a revolver 33' is attached to the stage/revolver holder 58, with its dovetail tenon fitted in the dovetail groove 58b of the holder 58. Further, a stationary stage fastener 60 is connected to the base 51, with the dovetail tenon 51a of the base 51 fitted in the dovetail groove made in the lower surface of the fastener 60. Next, a stage 59' is fixed to the stage fastener 60, with the dovetail tenon of the fastener 60 fitted in the dovetail groove made in the lower surface of the stage 59'. Finally, a specimen S is put on the stage 59'.

As has been described, the stage/revolver holder 58 is fixed to the movable support 25 in both the stage-moving mode and the objective-moving mode. In either mode, the holder 58 is moved vertically as the focus adjustment knob 27 is rotated in one direction or the other, thereby moving the stage 59 toward or away from the objective 34, or moving the objective 34 toward or away from the stage 59'.

As has been described, in the second embodiment, the specimen S is illuminated with the light beams applied by means of the reflected flood system shown in Fig. 8. Hence, the second embodiment requires no condensers at all.

Moreover, the second embodiment is advantageous in that its operating mode can easily be switched, from the stage-moving mode to the objective-moving mode, or vice versa, since the revolver can be attached to the arm top 53 or the stage/revolver holder 58, and the stage can be attached to the stage/revolver holder 58 or the stage

fastener 60.

Claims

1. A microscope comprising:

main unit (20) comprising a base (21), an arm body (22) mounted on and fixed to the base (21), an arm top (23), a revolver (33) attached to the arm top (23), an objective (34) attached to the revolver (33), a lens barrel (3) held by the arm top (23), and an eyepiece (3a) attached to the lens barrel (3);

a stage (38, 59) for supporting a specimen; a movable member (25) connected to the front of the arm body (22), opposing the specimen supported on said stage (38, 59), and capable of moving in vertical direction;

a revolver/stage holder (37, 40, 58) attached to said movable member (25), for selectively holding one of said revolver (33) and said stage (38, 59).

a focus adjustment knob (27) coupled to the arm body (22);

a focus-adjusting mechanism located within the arm body (22), mechanically connected to said movable member (25) and said focus adjustment knob (27), for moving the movable member (25) in the vertical direction for a distance proportional to an angle through which the knob (27) is rotated;

a first revolver holder (24) secured to the arm top (23), for holding the revolver (33); and

a stage support (41, 60) to be mounted on the base (21) in the case where the objective (34) is moved in order to achieve focusing.

2. A microscope according to claim 1, characterized by further comprising a lamp housing (57) containing a lamp for emitting light for illuminating the specimen, and a flood tube (56) located between the lamp housing (57) and said lens barrel (3), for guiding the light from the lamp housing (57) into said lens barrel (3).

3. A microscope according to claim 1, characterized in that said revolver/stage holder (40, 58) has a second revolver holder (40a, 58b) for holding said revolver (33).

4. A microscope according to claim 1, characterized in that said revolver/stage holder (37, 58) has a stage-holding portion (58a) for holding said stage (38, 59).

5. A microscope according to claim 1, characterized in that said revolver/stage holder (58) has a second revolver holder (58b) for holding said revolver (33), and a stage-holding portion (58a)

for holding said stage (59).

6. A microscope according to claim 1, characterized in that said revolver/stage holder has a condenser (39) for applying illumination light to the specimen from below.

7. A microscope according to claim 1, characterized by further comprising a positioning member (26) attached to said movable member (25), for supporting said revolver/stage holder (37, 40, 58) and preventing said revolver/stage holder (37, 40, 58) from moving at least downwards.

8. A microscope according to claim 7, characterized in that said revolver/stage holder (37, 40, 58) has a face on which said positioning member (26) is to abut.

9. A microscope according to claim 1, characterized in that said base (21) has a holder (31, 51a) for holding said stage support (41, 60).

10. A microscope according to claim 1, characterized in that said stage support (60) has a lower surface, an upper surface, a first engagement member formed on the lower surface and designed to engage with said base (21), and a second engagement member formed on the upper surface and designed to engage with said stage (59).

11. A microscope according to claim 1, characterized in that said movable member (25) has a dovetail tenon (25a) extending in vertical direction, and said revolver/stage holder (58) has a dovetail groove for receiving said dovetail tenon (25a) of said movable member (25), and a second revolver holder (58b) for holding said revolver (33).

12. A microscope according to claim 1, characterized in that said movable member (25) has a dovetail tenon (25a) extending in vertical direction, and said revolver/stage holder (58) has a dovetail groove for receiving said dovetail tenon (25a) of said movable member (25), and an engagement member (58a) designed to engage with said stage (33).

13. A microscope according to claim 1, characterized in that said movable member (25) has a dovetail tenon (25a) extending in vertical direction, and said revolver/stage holder (58) has a dovetail groove for receiving said dovetail tenon (25a) of said movable member (25), a second revolver holder (58b) for holding said

revolver (33), and an engagement member (58a) designed to engage with said stage (59).

14. A microscope according to claim 11, which further comprises a positioning member (26) attached to said movable member (25), for supporting said revolver/stage holder (37, 40, 58) and preventing said revolver/stage holder (37, 40, 58) from moving at least downwards, and in which said base (21) has a holder (51a) for holding said stage support (60). 5 10
15. A microscope according to claim 14, characterized by further comprising a lamp housing (57) containing a lamp for emitting light for illuminating the specimen, and a flood tube (56) located between the lamp housing (57) and said lens barrel (3), for guiding the light from the lamp housing (57) into said lens barrel (3). 15 20
16. A microscope according to claim 14, characterized in that said revolver/stage holder has a condenser (39) for applying illumination light to the specimen from below. 25
17. A microscope according to claim 1, characterized in that said revolver/stage holder (37, 40, 58) holds said revolver (33) and is attached to said movable member (25), and said stage support (41, 60) is mounted on said base (21), in order to move said objective (34) in vertical direction to perform focusing, and wherein said revolver/stage holder (37, 40, 58) holds said stage (38, 59) and is attached to said movable member (25), and said first revolver holder (24) holds said revolver (33), in order to move said stage (38, 59) in vertical direction to perform focusing. 30 35 40

40

45

50

55

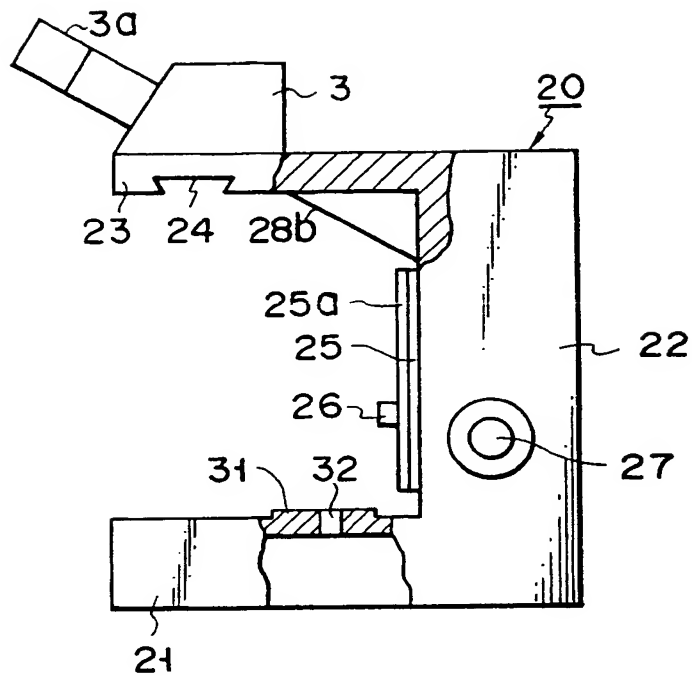


FIG. 1

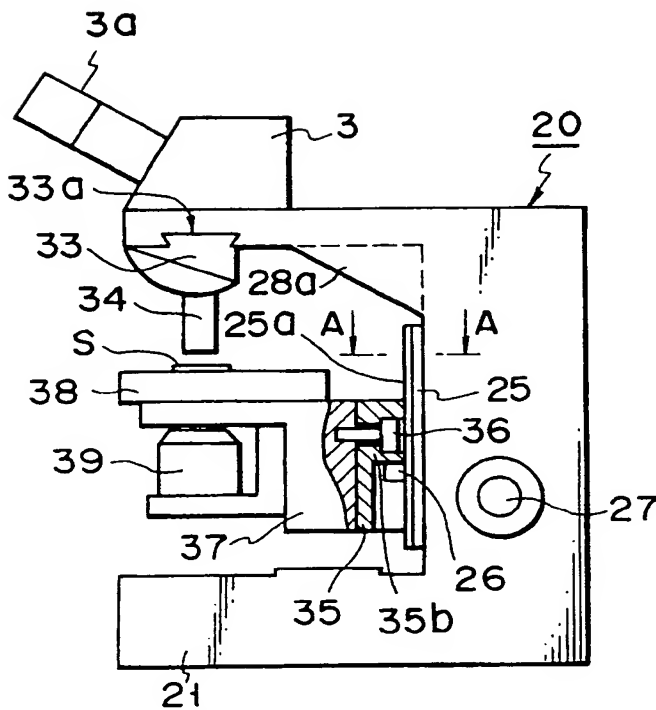


FIG. 2

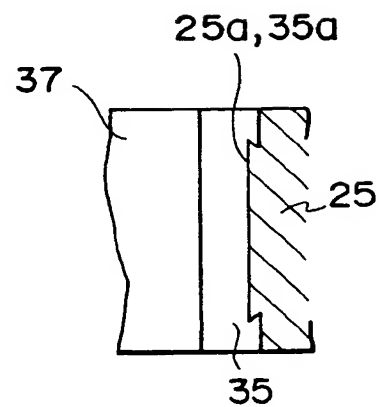


FIG. 3

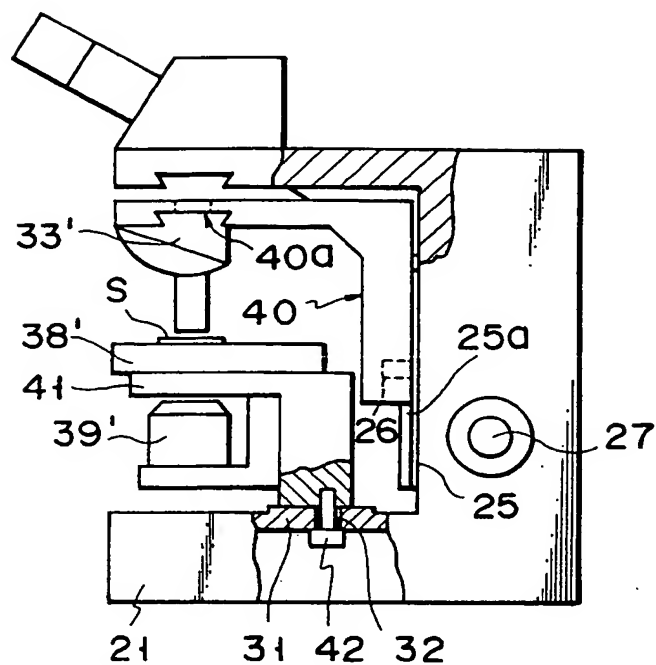


FIG. 4

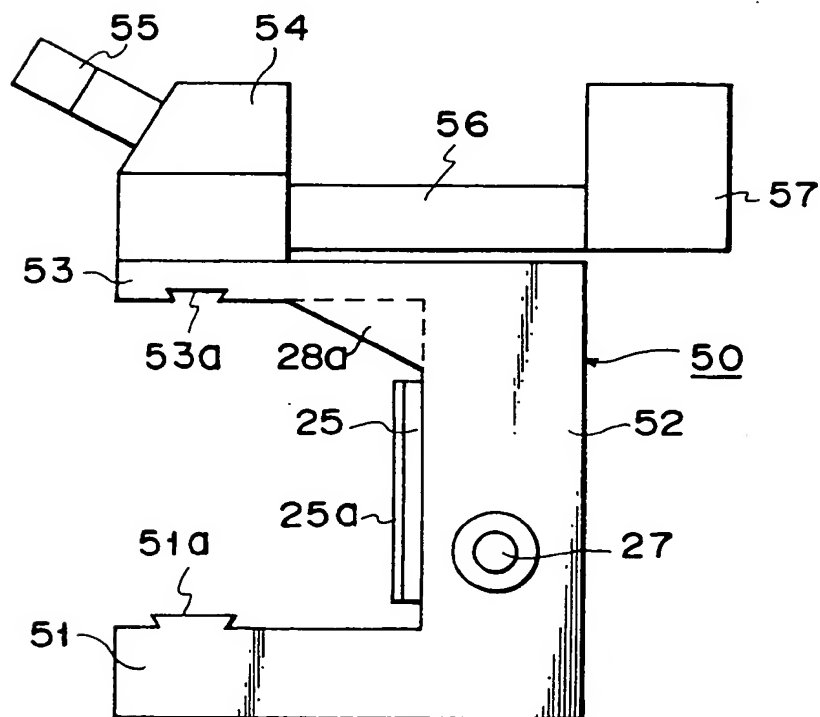


FIG. 5

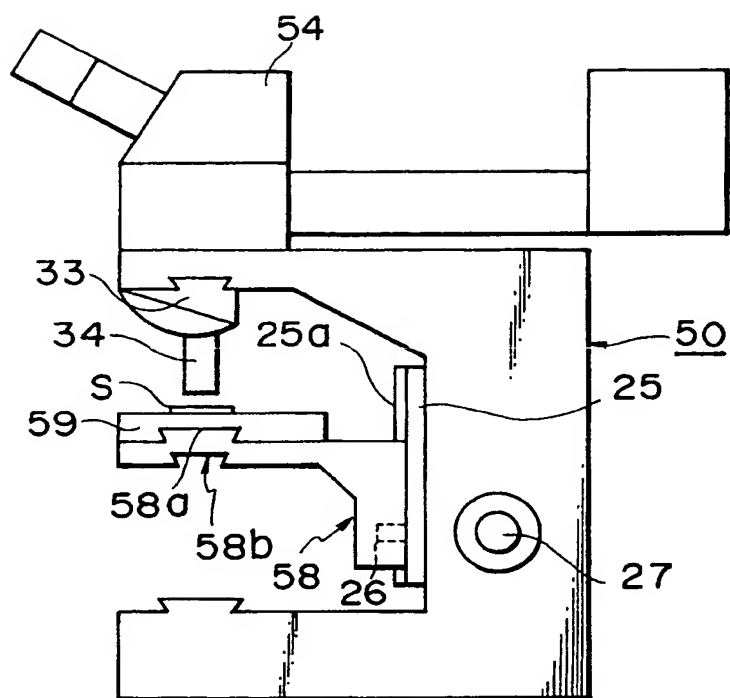


FIG. 6

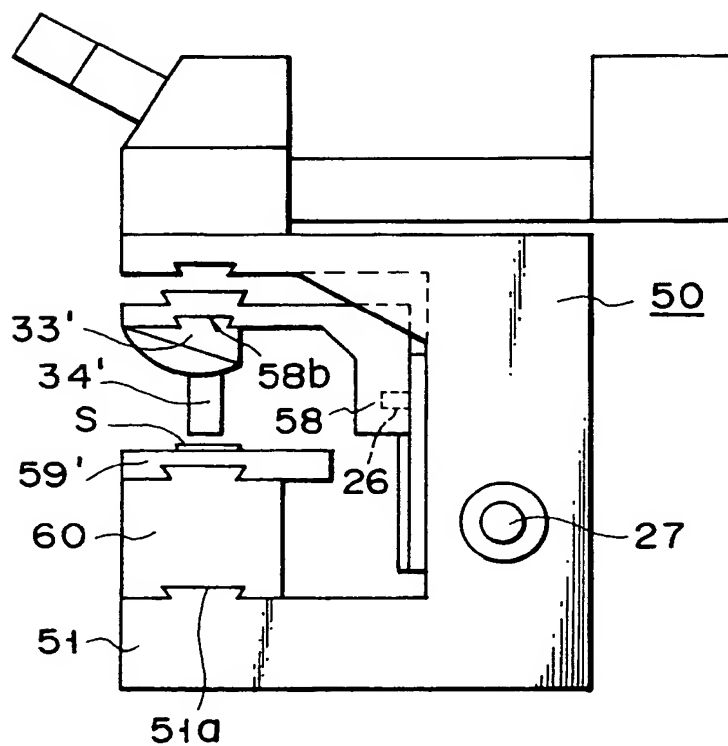


FIG. 7

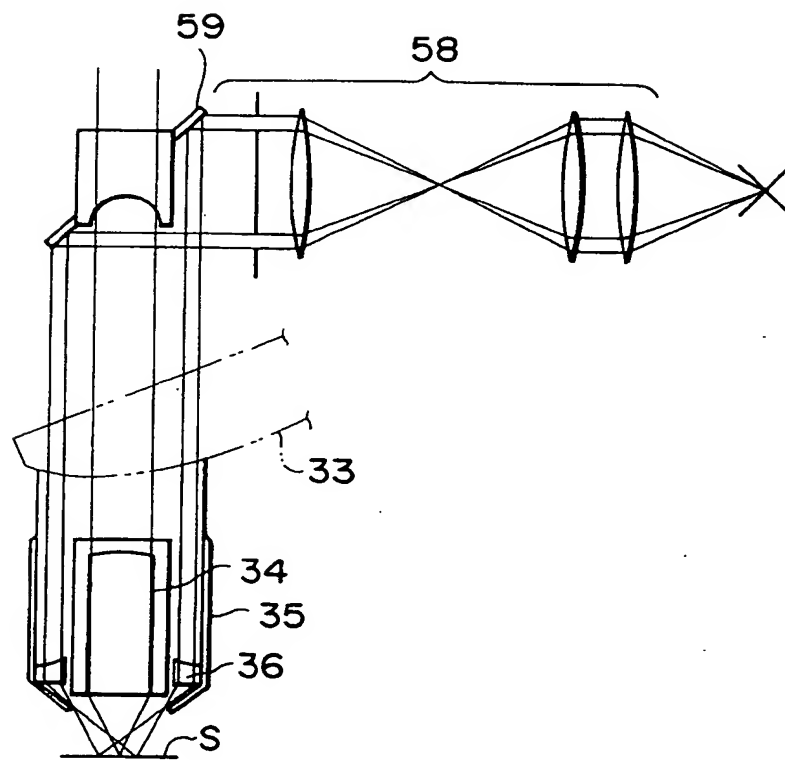


FIG. 8

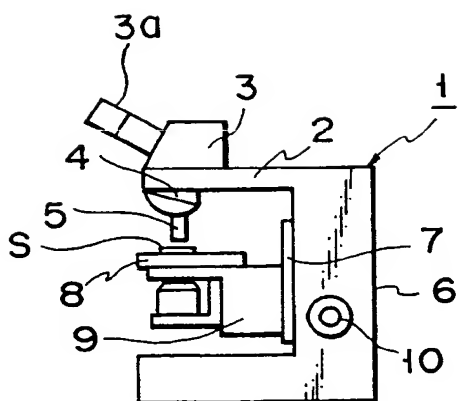


FIG. 9

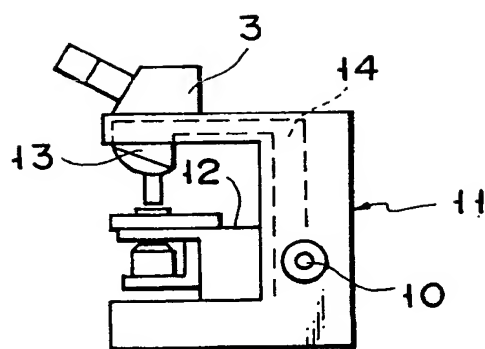


FIG. 10

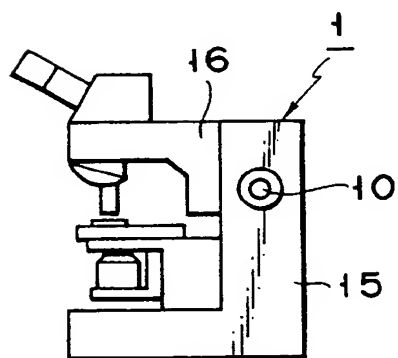


FIG. 11

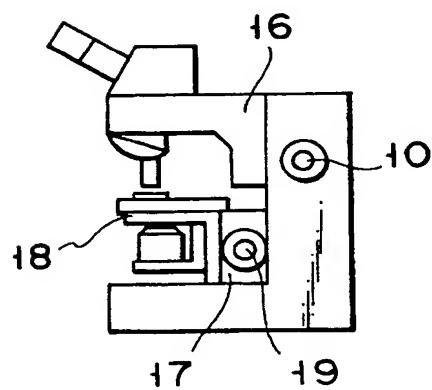


FIG. 12



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 9709

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-A-3 735 091 (OLYMPUS) * column 10, line 53 - line 60 * * figure 1 * ---	1, 4, 9, 17	G02B21/26
A	DE-A-3 641 048 (OLYMPUS) * figures 8, 15 * ---	1, 2, 17	
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 12 (P-421)(2069) 7 January 1986 & JP-A-60 168 118 (MITSUTOYO SEISAKUSHO) 31 August 1985 * abstract * ---	1, 2, 6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G02B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 03 APRIL 1992	Examiner WARD S. M.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 (01.92) (P0001)

THIS PAGE BLANK (USPTO)

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☒ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

THIS PAGE BLANK (USPTO)